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ABSTRACT

Education and teaching have changed in significant ways over the last decade. Since the late 1980s the Commonwealth of Australia has encouraged the development of "multi-skilled workers"; however, Alvin Toffler (1990) points out that changes in technology would create a deskilled work force with overly specialized, noninterchangeable skills. This paper presents findings of two studies that examined the effects of recent changes in Australian education on teachers' work lives. The first study was conducted in 87 primary and secondary schools in the state education systems of Tasmania and South Australia. A total of 100 teachers participated in a combination of interviews and a survey: 27 took part in interviews and the survey, 11 were interviewed, and 62 completed only the survey. Teachers reported that the educational reforms had resulted in increased paperwork; they had difficulty in dealing with externally imposed change and many simultaneous demands from varied sources; and they experienced time constraints. The second study involved case studies of 14 government schools/colleges identified as being innovative in the areas of pedagogy, curriculum, and/or staff development. Teachers were reflective about the process; willing to take risks; saw themselves as facilitators of active learning; and used student-centered, "hands-on" approaches. The schools focused on the key curriculum areas of mathematics, science, and technology. Three tables are included. (Contains 19 references.) (LMI)

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When Innovation Results in 'Deskilling': An unintended consequence of reform

by

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A paper presented as part of the symposium "From Butterflies to Brickbats or Bouquets: Teacher Expertise in a Changing Environment" at the annual meeting of the American Educational Research Association, New York, 8 April 1996.

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Introduction

Factors Contributing to the Perception of a Need for Change

There are at least three clusters of interrelated factors which are contributing to the press for significant change in teaching and education. The first of these is an economic cluster. It is often seen in the statements from politicians and business leaders who argue a simple causative link between education and economic growth, and which stresses the need to improve a nation's economic performance. An indication of the political emphasis in this cluster can be seen in Austria, for example. In the late 1960s all aspects of education were given political priority by all parties. This example of 'agenda agreement' was based on an expressed awareness of the role of education in the social and economic development of a nation. The second is the broad community and social concern about the quality of schooling. In the public expectations of schools clearly there is some gap between the perceived current practice and curricula and what the community says it wants. In some situations this gap reveals itself as being very large as expressed societal expectations have run far ahead of what actually occurs. The publication in 1983 A Nation at Risk in the United States is an indicator of this surge of interest and the resultant push for more and more detailed monitoring of teachers, schools and the system is now institutionalised. Finally, the third cluster relates to the rapidly changing and dynamic society schools and teachers are now confronting. This cluster involves such components as changing family structures, changes in cultural and individual values, new technologies and multiculturalism.

Changes in Schools

In the vast majority of countries there is agreement that schools in the 1990s are very different from those from even a decade ago. Schools have changed in many significant ways. Some of the changes include:

- the majority of young people now complete a full secondary school education. In Australia, for example, the retention rate to Year 12 has more than doubled over the decade and will approach 100 percent by the year 2000;
- there has been an increase in emphasise on curriculum and teaching processes to meet the aspirations of all students rather than focus on an intellectual or academic elite;
- there has been significant demographic transformation in the school population. The cultural and linguistic diversity now evident in schools is requiring fundamental change in all aspects. The size of this shift is illustrated in California where it is estimated over 50 percent of today's students come from so called "minority" categories;
- it is recognised and accepted that in content areas such as science, technology, mathematics, and social sciences the knowledge base of teachers (and teacher education programs), even if updated just a few years ago, is no longer sufficient to equip students to cope with the last decade of the 20th century, and certainly not enough to prepare them for the 21st century;
- schools, in particular in urban areas, are now asked to cope with students who come with many more physical, emotional and social problems than ever before; and
- there has been a change in the relationship between central systemic authorities and individual schools. In practice this has been shown in a significant devolution of responsibilities from central education authorities to individual schools and then local communities. There has been also a concomitant shift in how teachers' professionalism is viewed.

The above items when implemented represent major change in schools and schooling. In combination they radically alter all aspects of schooling; for example, curricula, teaching approaches and administrative arrangements.

The Concept of a Multiskilled and Deskilled Workforce

The Commonwealth of Australia since the late 1980s has encouraged the development of what is termed the 'multiskilled worker' (DEET, 1991). Part of the argument for this initiative is the belief that skilled operations in the information age will depend on the knowledge and experience of the individual worker, whereas in the preceding manufacturing age, the skill was built into the machinery (Warn, 1994). Consequently, investment in training and development is likely to be a major trend in Australian organisations. The Training Guarantee Act is designed to promote this.

On the other hand, as Toffler (1990) suggests, it may be that technology is forcing society into an information age in which workers become less interchangeable due to their unique skills and experience. In this situation it is possible to envisage members of the workforce who, through

external factors, no longer possess the skills required to do elements or all of the task for which they were first appointed.

This discussion while most usually considered when examining an industrial workforce can also apply to the educational workforce; that is, teachers and administrations.

PROJECT 1: AN EXAMPLE OF DESKILLING

Introduction

The situation in Australian educational settings is quite consistent with the scenarios depicted in the literature and, in all State education systems, contemporary change initiatives have appeared in many guises. Similarly, an emerging local interest in teachers' work (Carr, 1995; Connell, 1985; Crowther, *et al.*, 1994; Logan & Dempster, 1992) is coming to complement the international literature which describes the characteristics and feelings associated with the work lives of teachers (Huberman, 1993; Lieberman & Miller, 1992; Little & McLaughlin, 1993). In this context, research was conducted in two Australian State education systems with a view to discovering what effects recent educational changes were having on teachers' work lives.

Methodology

The study was conducted in 87 primary and secondary schools from the State education systems of Tasmania and South Australia. A multi-site, multi-method approach was adopted for the study, with 89 teachers completing a lengthy survey instrument and 38 teachers participating in semi-structured interviews. In all, 100 teachers participated in the study: 27 of these participated via both interview and survey, 11 respondents were interviewed but not surveyed, while the remaining 62 teachers participated through the survey alone. The survey data were gathered to supplement the interview data and to assist in examining the problem from a variety of perspectives and through a number of lenses. Matters related to three research questions are examined briefly in this paper:

1. Which educational changes do teachers see as having the greatest impact on their working lives?
2. How do teachers see their working lives being affected by educational changes?
3. How do teachers feel about educational changes and the quality of their work lives?

The sample of teacher respondents was not selected randomly. Rather, participants were chosen from randomly selected schools, with these being collectively representative of the types and locations of schools found within the State education systems of South Australia (S.A.) and Tasmania (Tas.). The participating teachers (defined as those who spent at least 80 per cent of school-hours instructing students) were identified through negotiations between the principal researcher, the respective school principals and those teachers at each school who had expressed their willingness to be part of the research process. The demographic details of the sample are detailed in Table 1 below:

Table 1: The Sample: Demographic Details

	Survey (n = 62)	Survey & Interview (n = 27)	Interview (n = 11)	Total Sample (n = 100)
State System	S.A. 31 Tas. 31	S.A. 14 Tas. 13	S.A. 6 Tas. 5	S.A. 51 Tas. 49
Gender	Male 23 Female 39	Male 12 Female 15	Male 6 Female 5	Male 41 Female 59
School Level	Primary 35 Secondary 27	Primary 16 Secondary 11	Primary 4 Secondary 7	Primary 55 Secondary 45

All interviews were conducted at convenient times in private at each interviewee's school during the second and third weeks of the final term of the 1994 school year. The surveys were distributed at the same time.

In order to guard against sole interviewer effects, two research assistants were trained to conduct half of the interviews. Thus the 18 Tasmanian interviews were shared between the principal researcher and one assistant, while the 20 South Australian interviews were shared between the principal researcher and a second assistant.

Themes from the Data

A Shift in the Focus of Teachers' Core Work

For many respondents an apparent shift in focus away from their contacts with students in the classroom and toward documentation and administration was a particularly unwelcome effect of educational change. This was a recurring theme, amounting to teachers mourning the loss of that which they had long claimed as the *raison d'etre* of their role: working constructively with students. Teachers' comments included the following:

> *I spend too much time hassling with the paperwork instead of actually teaching. If you're spending more time doing the written work, you've got less time to put into actually teaching and preparing.*

> *It has changed my attitude to teaching compared to my attitude when I first started teaching. The focus then was on working in the classroom and on getting things done in the classroom. The focus now has shifted to the paperwork associated with classrooms.*

Surviving and Coping

While these teachers reported difficulties in understanding and accepting new processes, procedures and expectations associated with educational changes of all varieties, many teachers had been able to surmount most of their problems and, within a relatively short time, come to terms with the requirements of the innovations.

> *My current feelings are that we are over the hump - it's a bit of a "been there, done that" feeling. I am a bit tired, I guess, but more confident. There was a bit of trepidation in the beginning but what seemed to be insurmountable was eventually surmountable.*

Some teachers had seemingly developed some self-protective attitudes as part of their response to change initiatives, as the following remarks indicated:

> *You've got to learn to go with the flow. If you don't go with the flow, you'll go around the bend.*

> *My attitude is, no matter what bureaucracies give teachers to do in the classroom, you eventually find a way of coping with it - whether you do it properly or whatever is up to the individual teacher.*

Unfamiliar Practices Replacing Established Work Patterns

Teachers interviewed felt most affected by educational changes when their confidence concerning their work was threatened or disrupted by expectations about which they felt uninformed. Comments indicative of this belief included the following from two primary teachers discussing the introduction of national curriculum profiles:

> *A lot of your so-called free time - your extra time - is taken up with just deciphering what you are supposed to be doing.*

> *I reckon they just designed them and said, "Okay, we've done our job. Now it's your job to implement them - off you go!" Nobody really knew what to do.*

External Imposition

Australian teachers engage in a considerable level of locally-based innovation efforts, however, the teachers in this study described the changes which they thought affected their work most significantly

as being imposed externally by central administrative authorities and governments. Thus, it seems that changes which originate outside these teachers' work settings and which are presented as mandatory, are seen by them as most problematic for their work lives.

When discussing the origins of changes and how these are presented to them, teachers interviewed gave two types of responses. The first type of response was brief and to the point, as in the two following examples:

> *The stuff came out of the blue really. Here it was - and then we had to implement it all by a set date.*
>
> *It's just fed down through the system, "Here it is, go and do it!" To me it always seems to be from high-up in the hierarchy.*

The second type of response was more lengthy, but no less explicit about the teachers' lack of perceived ownership of most innovations. Two comments illustrate this position.

> *It was very much pushed on you. It was almost, "Well too bloody bad - it's coming in and you've just got to put up with it". And although it was sugar-coated a lot - they weren't that rude - you couldn't get away from the fact that the changes were being forced on you.*
>
> *Certainly it was: "No correspondence will be entered into". And having been told that, it was then up to us to make it work, so that we could continue to function within a new system and so that the students wouldn't suffer in the transition. But I don't ever feel that if we had made enough noise that anything would have changed - it was a 'fait accompli'.*

Multiple Simultaneous Innovations

The teachers expressed concerns in the interviews about the number of different change initiatives being promoted simultaneously. They felt that there was little acknowledgment of the effect of this multiplicity of innovations on teachers who already see themselves as committed fully in the day-to-day tasks associated with working with their students. Perhaps more than anything, teachers saw this situation as counter-productive in the sense that the multiplicity of demands limited the extent to which teachers could implement any one innovation effectively.

In South Australian context, comments from a secondary teacher, followed by remarks from a primary colleague, typify the teachers' perceptions of the situation:

> *The range of change is so much, it's so unco-ordinated and it comes from a variety of places. It's very, very hard: it makes things very complex, makes people very frustrated and probably doesn't work efficiently either.*
>
> *I just want to be a teacher for a while. Just leave me and the children alone for a while; let us be comfortable. We have been trying so hard over the last five years we haven't really let anything settle. Sometime, somewhere, they have got to stop banging the side of the chook shed. You know, it's bombardment all of the time.*

The Tasmanian teachers saw the situation in the same light. The first of the following comments was made by a secondary teacher, while the second is typical of those made by primary teachers.

> *You are not just talking about a change in isolation, it's in combination. If there is something else suddenly thrown in at you, as there always is, you just go into overload.*
>
> *So it's not really the change itself that creates that feeling, it's just the fact that it's another change in a succession of changes.*
>
> *It's just so hard when there is so much being imposed as well as these other things that we have to respond to in the classroom just for survival. It is an enormous amount to take on board and nobody can possibly do it all at once.*

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Abbreviated Timelines

Teachers see implementation timelines established by others as unrealistically short. On the other hand, these same timelines appear reasonable, presumably, to the people who have the facilitation and promotion of a particular change initiative as the single focus of their current work in an education system.

Not a single teacher in the sample felt that sufficient time had been available for effective implementation:

> *There was all this new jargon and no one knew what it was about. You could go to a PD (professional development) session; but then you were supposed to be doing it the next week in your room. We had to take it on board straight away. The inservice was too intensive in too short a time and there was no time for reflecting, internalising or evaluating what you'd learned.*
>
> *There just wasn't time to come to grips with the issues involved; there was a lack of time to work collaboratively, a lack of time to implement and a lack of PD.*

PROJECT 2: MULTISKILLING AND PROFESSIONAL EMPOWERMENT

Schools Involved

The Project Director negotiated selection of and access to the schools and colleges with senior Department of Education and the Arts (DEA) officials. The DEA staff suggested 14 government schools/colleges which they identified as being innovative in pedagogy, curricula and/or staff development. The Project Director contacted all schools nominated and ten agreed to participate. Table 2 shows the curriculum area and the nature of the participating school/college.

Table 2: Curriculum Area, Location and Level of Participating Schools/Colleges

Curriculum Area	Participating Schools or Colleges
Science (n = 4)	Exeter Primary (rural); Lilydale District High (rural); Cosgrove High (urban); Launceston College (urban).
Maths (n = 3)	Claremont Primary (urban); Smithton High (7-12) (rural); Elizabeth College (urban).
Technology (n = 4)	Lauderdale Primary (urban); Penguin High (rural); Reece High (urban); Elizabeth College (urban).

The Impetus for Change: Origins, Purposes and People

Context

The case studies exhibited a range of starting points for the innovations described. These included the following.

(1) Staff concerned with:
- (a) pedagogy;
- (b) curriculum (including Key Competencies);
- (c) their professional development; and
- (d) staff-student relationships.

(2) Schools concerned with:
- (a) teacher professional development;
- (b) curriculum (including Key Competencies);
- (c) their organisational structure;
- (d) school to work transition; and
- (e) community relationships (including parental support).

(3) State and federal government departments (*ie* DEA and DEET) concerned with:
- (a) a framework for curriculum (including Key Competencies);
- (b) professional development;
- (c) pedagogy; and
- (d) school to work transition.

Table 3 shows which innovation starting points were important for each of the case study schools.

Table 3: Innovation starting points of case study schools.

SCHOOLS / Innovation Starting Points		CPS	CHS	EC (M)	EC (T)	EPS	LC	LD HS	LPS	PHS	RHS	SHS
Staff	Pedagogy	X	X			X		X		X		X
	Curriculum	X	X	X	X	X	X	X	X	X	X	X
	Professional Development	X				X					X	
	Student-Teacher Relationships						X					X
Schools	Professional Development		X						X			
	Curriculum		X	X		X	X	X		X		
	Organisational Structure				X		X	X		X	X	
	School to Work Transition			X	X		X					
	Community Relationships				X				X			
Government	Curriculum	X		X		X		X		X		
	Professional Development	X				X						
	Pedagogy	X								X		
	School to Work Transition			X			X					

National Statements and Curriculum Profiles

The *National Statements and Curriculum Profiles* were produced and initiated by the Australian Education Council (AEC) as part of a joint project by the states, territories and the Commonwealth of Australia. This national collaboration produced 16 documents: a statement and a profile in each of the eight key learning areas - English, Mathematics, Science, Technology, Languages Other Than English (LOTE), Health and Physical Education, Studies of Society and Environment, and the Arts.

The Statements

The statements provided a framework for curriculum development by education systems and schools. They were divided into strands which reflected the major elements of learning (content and process) in each area. Further, they were structured in four bands, roughly corresponding to the stages of schooling: lower primary, upper primary, junior secondary and postcompulsory. The statement provided some elaboration of each strand but did not provide a syllabus.

The Profiles

The profiles were designed to assist in the improvement of teaching and learning and to provide a common language for reporting student achievement. They were divided into strands for each key learning area. Within each strand, eight achievement levels were developed. Overall, the eight levels reflected the full range of student achievement during the *compulsory* years of schooling.

Strands

Science

Science was organised into five strands; one process strand and four conceptual strands. The conceptual strands reflected the traditional organisation of Science into the distinct areas of study of

Earth Science, Physics, Biology, and Chemistry. The five strands covered selected aspects of science concepts and processes, as indicated:

(i) Working Scientifically (using science; acting responsibly; investigating);
(ii) Earth and Beyond (Earth, sky and people; the changing Earth; our place in space);
(iii) Energy and Change (energy and us; transferring energy; energy sources and receivers);
(iv) Life and Living (living together; structure and function; biodiversity, change and continuity); and
(v) Natural and Processed Materials (materials and their uses; structure and properties; reactions and change).

The process strand, Working Scientifically, was intended to be integrated with the conceptual strands.

The Statement outlined seven principles for effective learning experiences in Science. These were:

(i) taking account of students' views;
(ii) recognising that students construct their own understandings;
(ii) providing a supportive learning environment;
(iv) learning in practice;
(v) engaging in relevant and useful activities;
(vi) complementing learning in other areas; and
(vii) using scientific language appropriately.

Mathematics

Mathematics was organised into eight strands, which overlapped and inter-connected. The breakdown of each strand into subheadings is indicated:

(i) Attitudes and Appreciations (attitudes; appreciations);
(ii) Mathematical Inquiry (mathematical expression; order and arrangement; justification; problem-solving strategies);
(iii) Choosing and Using Mathematics (applying mathematics; mathematical modelling);
(iv) Space (shape and structure; transformation and symmetry; location and arrangement);
(v) Number (number and numeration; computation and estimation);
(vi) Measurement (measurement and estimation; indirect measurement; approximation, change and the calculus);
(vii) Chance and Data (chance; data handling; statistical inference); and
(viii) Algebra (expressing generalisations; functions; equations).

The statement outlined four learning principles and five implications for teaching.
Learning Principles:

(i) learners construct their own meanings from, and for, the ideas, objects and events which they experience;
(ii) learning happens when existing conceptions are challenged;
(iii) learning requires action and reflection on the part of the learner; and
(iv) learning involves taking risks.

Implications for Teaching: mathematics learning is likely to be enhanced by:

(i) activities which build upon and respect students' experiences;
(ii) activities which the learner regards as purposeful and interesting;
(iii) feedback;
(iv) using and developing appropriate language; and
(v) challenge within a supportive framework.

Technology

Technology was organised into four interdependent strands:

(i) Designing, Making and Appraising (a process through which students develop ideas and imaginative solutions for learning tasks);
(ii) Information;
(iii) Materials; and
(iv) Systems.

All learning in technology was intended to involve the Designing, Making and Appraising strand. When students design, make and appraise they:

(i) investigate issues and needs;
(ii) devise proposals and alternatives;
(iii) produce processes and products; and
(iv) evaluate consequences and outcomes.

"The tasks and activities in technology programmes assist students to identify questions to explore, to synthesise ways to put ideas into practice, and to implement plans." (Australian Education Council, 1994b, 6) Students are encouraged to:

(i) build on their experiences, interests and aspirations in technology;
(ii) find and use a variety of technological information and ideas;
(iii) show how ideas and practices in technology are conceived;
(iv) explain technical language and conventions;
(v) take responsibility for designs, decisions, actions and assessments;
(vi) trial their proposals and plans;
(vii) take risks when exploring new ideas and practices; and
(viii) be open-minded and show respect for individual differences when responding to technological challenges.

The Key Learning Areas: Mathematics, Science, Technology

Mathematics and Science have been traditional Key Learning Areas. Technology, however, has drawn on a wide range of subject areas, including the traditional areas of Home Economics, Manual Arts, Computing and Technical Drawing.

The following definitions of the Key Learning Areas are extracts from the *Learning Area Direction Statements* (1994) published by the Department of Education and the Arts. These statements were part of a folio of materials designed to assist teachers with the nationally developed directions in curriculum.

Mathematics

> *Mathematics is often defined as the science of space and number ... [but] a more apt definition [is that] it is the science of patterns. The mathematician seeks patterns in number, in space, in computers and in imagination. Mathematical theories explain the relations among patterns. Applications of mathematics use these to 'explain' and predict natural phenomena ... (Australian Education Council, 1991, 4)*

Mathematics is fundamental to the study of other fields of learning including the physical sciences, engineering, the social sciences, computer science and the biological sciences.

Science

Science education helps students to understand the major concepts and processes used in science and how these relate to them and their world. Science teaching is concerned with encouraging students to test their assumptions, ideas and beliefs.

Science is a universal discipline through which people investigate the living, material, physical and technological components of their environment, and make sense of them in logical and creative ways. It helps people to investigate phenomena systematically, to clarify ideas, to ask questions, to test explanations through measurement and observation, and to use their findings to establish the worth of ideas.

Science and technology are inextricably linked. Science and technology are contributing to an accelerating rate of change in our society. As tomorrow's adults, today's students will be required to make responsible decisions and informed choices about the ramifications of science and technology, both in their immediate lives and in wider local, national and international contexts.

Technology

> *Technology is often used as a generic term to include all the technologies people develop and use in their lives. It involves the purposeful application of*

> *knowledge, experience and resources to create products and processes to meet human needs. (Australian Education Council, 1994b, 3)*

Materials, Design and Technology (Design and Technology, Design in Metal, Plastic and Wood), Design Graphics, Food and Textiles, Keyboarding, Information Technology, Media Studies, Applied Power Technology, Agriculture, Computer Aided Drafting and Design (CAD) and Electronics are established areas that gain new purpose and direction in this learning area. Technology acts as a unifier of these areas, giving them all a common framework within which to work.

Teachers in Change

The Role of Teachers

The case studies demonstrated a significant shift, often aided by appropriate professional development, in the role of the teacher and highlighted the following points.

(1) The teachers involved in the innovations were *reflective* on:
   - (i) their own practice (*eg*, the senior school science teacher at LDHS);
   - (ii) appropriate curriculum (*eg*, science teachers at LC);
   - (iii) models of learning (*eg*, the Key Teacher in mathematics at SHS); and
   - (iv) the role of the school or college in the community (*eg*, technology teachers at EC).

   As a consequence, the following *practical* outcomes could be seen:
   - (i) implementation of a repertoire of teaching strategies;
   - (ii) curriculum redevelopment and broadening;
   - (iii) adoption of constructivist (*ie*, knowledge is not transmitted in a fixed and final form from one person to another, but is actively created by the learner) views on student learning;
   - (iv) greater collegiality between teachers in all aspects of pedagogy, curriculum and professional development;
   - (v) involvement of parents in the school; and
   - (vi) a clear, practical articulation of school activities with vocational pathways.

(2) The teachers were more willing to *have a go*, (*ie* take a risk). This was expressed in the nature of their relationship with:
   - (i) curriculum material;
   - (ii) teaching strategies;
   - (iii) colleagues;
   - (iv) school administration; and
   - (v) the wider community.

(3) The teachers conceptualised their role more as a facilitator of active learning rather than as a possessor of content which needed to be transmitted to passive learners.

The teachers at Claremont Primary School, worked together to gain familiarity with the curriculum documents in order to develop the Mathematics Overview. They worked as a whole staff, in small groups, and as individuals in clarifying, analysing and discussing aspects of the publications. There was provision for teachers to try out ideas in their own classrooms and to reflect and analyse their own teaching in light of the new curriculum documents. A supportive, friendly and relaxed atmosphere was maintained. Teachers commented that they developed a clearer understanding of the emphases of the nationally developed and Tasmanian mathematics curriculum documents. For example, one grade 3 teacher stated:

> *It is not a set prescriptive curriculum, but you have got to make sure that for it to work nationally that you are looking at the outcomes and seeing where you are heading ... But me personally, having gotten through it, I can look back and say my understanding of my teaching of maths has definitely broadened and I feel much more happy and I can see where I am going and the way I approach maths in the classroom has definitely changed.*

At Cosgrove High School, science teachers were allocated time out of class to work together to develop a new approach to curriculum planning and delivery for science. The activities undertaken consisted of a period of study of relevant government documents and then four different writing teams wrote outlines of each of the strands (as outlined in the *National Statement and Curriculum Profile for Science*). These teachers then trialed the materials and teaching approaches in their classrooms,

discussed and shared their experiences and individually reviewed their own curriculum and teaching methods.

At Exeter Primary School, the teachers on the Science Committee (including the Science Resource Teacher) took on new roles within the school as well as their traditional teaching roles. Initially they undertook a series of five professional development workshops organised by the Science Resource Teacher, with the support of the Principal Curriculum Officer for Science, in order to develop the curriculum broadsheet and links maps for the new science program. The final workshop held in October 1994 involved the whole school staff so that the Science Committee could share their ideas and the newly developed program with the rest of the staff. The Science Resource Teacher stated:

> *Next year [1995] I will be running little sessions every now and again. For instance, I might get someone who is really good at doing visualising lessons to run a visualisation session at the staff meeting or someone to do design briefs. Some people just about go spare having to do these. But if someone can tell us how to go about it then it is going to arm people with more strategies and I guess that is what they need - more strategies. People feel frightened because they are not quite sure what to do and where to go.*

She later added:

> *I really felt it would be crucial that I had highly interested people, an amount of expertise, and a balance across the school so that all those things are reflected in the materials we developed; and as well all along the way, we reported back to the staff what we were doing and we did surveys and gathered information from them so the rest of the staff were in on it all along the way.*

In addition to effort being made to share the outcomes of the workshops with other staff members through several short staff meetings, a display board in the school staffroom encouraged Key Teachers to share ideas they had tried following the workshops. Therefore, through the work of the Science Committee, the whole school became committed to the science program. Additionally, Exeter Primary School made an effort to keep the parent community informed of the developments in science from the beginning of the innovation. Parents were enthusiastic about the science initiative, which was a reflection of the enthusiasm of their children for the science program.

Teaching Methods

The case studies showed a shift in pedagogy from a teacher-centred, didactic approach to a more student-centred approach of self-initiated learning. The teacher, in broad terms, had become a facilitator of students' learning and the students, concomitantly, had become more responsible for their own learning. This shift in emphasis concurred with the teaching approaches outlined in the *National Statements and Curriculum Profiles*.

Changes in teaching approaches included:

(i) a more *hands-on* approach (*eg*, a *tinkering* table for science students at EPS);
(ii) use of the *design, make and appraise* model, including design briefs (*eg* at LPS, PHS and EC);
(iii) greater student responsibility for their own learning, including self-paced learning (*eg*, at PHS and SHS);
(iv) peer-tutoring (*eg*, at LPS and EC);
(v) group work
(vi) greater emphasis on 'real world' problems (*eg* CPS and SHS);
(vii) attempts to link subject with others; that is, emphasis on cross-curricula work (*eg*, at EC and RHS); and
(viii) a learning focus on process rather than product (*eg*, at PHS).

<u>A more hands-on approach</u>

A grade 3 teacher at Claremont Primary School commented, "yes, we do do a lot of oral activities and yes, we do do a lot of *hands-on* activities" and a grade 6 teacher at Claremont Primary School commented:

> *I try to have a mixture of different things - lots of hands-on things. I try to make things that actually make sense, not just doing the things but actually*

> *understanding what they are doing... I probably like the things that we do which are more hands-on but then again they might not even realise that that is a part of maths. They just see some sort of fun activity and not actually relate it back.*

In support of this, a grade 4 student at Claremont Primary School commented in their journal:

> *Today also we done work with shapes, we had to make animals out of shapes, I thought it was interesting.*

At Cosgrove High School, students were observed making a video to present information on space research; and, in pairs, drawing an outline around each other's body, then drawing in where they thought body organs were placed.

The science program at Exeter Primary School had a strong *hands-on* emphasis. Design and construction were part of the challenge in this subject. As an aid to this, the Science Room included a *tinkering* table, equipped with a basic tool kit where students were able to dismantle household items such as toasters, a TV and electric irons to see how things worked. This area was very popular. Additionally, an observed grade 6 activity involved children learning about gear systems on bicycles. The central space in the Science Room allowed children to have several bicycles inside for observation and practical exercises. The Science Resource Teacher commented on the various approaches people could use.

> *They might brainstorm. They might do a concept map. they might do a visualisation. They might do a drama. they might do a design brief. We encourage them to decide their intention; decide their key idea and then decide how they are going to introduce it.*

Teachers at Smithton High School attempted to introduce more *hands-on* activities into their mathematics classes. Grade 7 students at Smithton High School commented in their journals:

> *We learnt about comparing fraction by using the length of two people's stride. It's a different way to learning fractions and it makes it easier.*

> *It was good that we went outside to try the problem out. It helped me understand what we were doing.*

<u>Use of the design, make and appraise model, including design briefs</u>

Design briefs were used by teachers at Exeter Primary School; an example being:

> *A cook accidentally mixed too much salt into a bowl of flour and spilt some bicarb into another bowl of icing sugar. What tests could be undertaken to identify which bowl contained which ingredients? Devise ways to separate the ingredients.*

At Lauderdale Primary School, design briefs and project-based work, applying the *design, make and appraise* model, were used by some teachers throughout their work. Design briefs involved the students in reflective processes; whether they were being asked to write a story or design a room, they had to consider the purpose of the work and the materials available, and design and make and continually appraise the match between their product and the required outcome. Project-based work, whether by individuals or groups, enabled children to be taught and to learn at their own pace, with the teacher able to work with small groups facilitating the learning. A grade 5 teacher set most work in the form of design briefs; for example, in an extended unit on human shelter he set many briefs, one of which was the following:

> *Past Shelters: Research and choose a shelter from the past. Prepare notes and graphics and a model. Show what the shelter provided and what kept it going. What lifestyle did the group have? What time was the shelter made? Where? Was it part of a larger group; village, town or city?*

At Penguin High School, lesson plans using design briefs were based on the *design, make and appraise* procedure. The use of the design briefs was most obvious in the MDT and Food and Textiles classes. It was obvious when observing the classes and watching students working through

the *design, make and appraise* process, working together gathering information and sharing ideas, that the goals the teachers had for their students and their subject were being reached.

Greater student responsibility for their own learning, including self-paced learning
At Cosgrove High School, students designed and planned their own experiments; for example, grade 7 students were observed conducting experiments in groups for which each group had devised their own experiment to test the strength of different types of paper. Students made the following comments about the lesson in their journals:

> *First we made a plan of how to test the strength of toilet paper, tissues and paper towelling. We held the paper in a clamp, tied string to it and used a force measurer [spring balance] to measure the strength.*
>
> *I carried out the experiment of which I devised (with Nathan) myself, to see how strong different paper is. Our idea of testing was a complete failure because we didn't have the equipment we needed.*
>
> *We had a lot of freedom because it was our ideas for the experiment, not no one else's.*
>
> *It was fun to do our own experiments for once, instead of experiments we were told to do.*
>
> *It was interesting to see what other groups had as their plans and it was also interesting carrying out the experiments on our own.*

Conclusion

A statement which summarises many of the points mentioned above in Project 2 was described by a Research Assistant who used the metaphor of *the wave* to explain innovation and change. She wrote:

> *Innovation and change may be perceived as a wave. It can be a long roller which one prepares students to ride, and those who ride it best right now may be those who are trained to handle exactly that one type of wave to its greatest potential. But it could change shape or be a dumper, in which case the students need skills in recognition and prediction and decision making as to whether to go for it, stay with it, back off it, or dive under it. It may roll into unknown waters, in which case the student will require both knowledge and a flexibility to apply that knowledge to new situations. Many teachers are not swimmers, or have no confidence in fast moving big seas. Some perceive the wave as a potential tidal wave and fear their inability to cope and to prepare their students to even survive or float, let along to surf with it. School managers can perceive the waves as threatening to crash down and demolish their organisational structures. Yet others see the wave as offering an inspirational and energetic ride to both new and old places and experiences, and strive to make all their students confident and eager to ride the wave.*

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